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Development of an edible, bio-based nanostructure for the encapsulation of water-soluble vitamins

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Vitamins are organic molecules with small dimension and low molecular weight. They are present in food and are essential for normal operation of human metabolism. Vitamins are in general very sensitive and unstable when exposed to inappropriate temperatures, oxygen, light, and humidity. For the food industry it is important to reduce some of these limitations and to provide higher stability and longer shelf life of vitamins. Encapsulation, through the utilization of nanostructures, arises as a promising solution for this problem. The objective of this work was the development and characterization of a nanostructure for encapsulation of riboflavin (vitamin B2) using edible materials. Ionotropic polyelectrolyte pre-gelation was used as production method and the biopolymers chitosan and alginate were used as main materials. Alginate and chitosan are biodegradable, biocompatible, food-grade, have good physicochemical properties, and can be used to the development of nanostructures in order to protect vitamins against aggressive environments/conditions. Alginate pre-gelation was triggered with Ca^{2+} counterion, followed by polyelectrolyte complexation with chitosan. Alginate nuclei retain vitamins and are stabilized when coated with chitosan. Through a factorial experimental design the optimal concentrations of alginate, chitosan and encapsulated vitamin were determined, being, respectively, 0.063% (w/w), 0.04% (w/w), and 0.0095% (w/w). The characterization of the nanostructures was performed through Dynamic Light Scattering (size and polydispersity) and the vitamin entrapment efficiency was determined. The average size of nanoparticles without and with vitamin B2 was 99.95 nm ± 23.77 nm) and 96.65 (± 11.07 nm) by number, respectively. The polydispersity was 0.50 (± 0.079) without vitamin and 0.652 (± 0.040) with vitamin. Vitamin entrapment efficiency was approximately 70% for the mentioned vitamin concentration. This work provides important information concerning nanoencapsulation of water-soluble vitamins showing that using alginate/chitosan nanostructures can be of great potential for the application in food products.